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STUDIES ON PHENOLOGY, SEED DEVELOPMENT AND MATURATION IN LAMB'S QUARTERS (*CHENOPODIUM ALBUM* L)VAR. OOTY (CK) 1

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ABSTRACT

The phenology study in Lamb's quarters (Chenopodium album L.) revealed that the spike initiation started from 35 days after sowing (DAS) and completed at 40 DAS. The flowering period initiated at 43 DAS and reached 50 per cent at 54 DAS and completed at 65 DAS. Seed development and maturation results showed that the seed takes about 45 days to attain its physiological maturity from the anthesis. Eight different stages of seed development were observed based on the changes in seed colour. Therefore, seed was greyed brown (RHS N199A)in colour and possess 12.7 per cent moisture content at the time of seed maturation. Also the maximum seed fresh weight (2.20mg seed^{-1}) and dry weight (1.55mg seed^{-1}) were noticed at that time. In addition, the seed has dormancy at the time of physiological maturation and therefore, it needs dormancy breaking treatment for instant sowing.

***KEYWORDS*: Chenopodiumalbum, Chakkaravarthikeerai, Phenology & Seed Development and Maturation**

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Original Article

INTRODUCTION

Lamb's quarters (*Chenopodium album*L) is a leafy vegetable belongs to the family Amaranthaceae. It is a fast growing annual plantgrown well in tropical and subtropical region with nitrogen rich soil. It has recently gained worldwide attention due to its nutritional value. Economically the leaves and stems are used as vegetable, either raw or cooked and the tender leaves are used in many Indian dishes. In the Himalayan region it is considered as an important subsidiary grain crop, as a pot herb for secondary fodder and salad dressings (Bhargava *et al*., 2007). This leaves are rich in vitamin A and C, essential oils, minerals particularly potash and considerable amount of albuminoids and nitrogen. The root contains saponin and two flavonoids *viz*., kampferol and quercetin. Therefore, it is widely used in folk medicine around the world. Particularly, it is used in the treatment of rheumatism, bug bites, sun stroke, urinary problems, skin problems etc. Also, the plant has medicinal values like laxative property and act as a blood purifier (Sanwal, 2008). Therefore, considering its importance and economical value Tamil Nadu Agricultural University (TNAU) has released a variety in Lamb's quarters (*Chakravarthikeerai*) named'Ooty (Ck)1'. This variety is rich in protein (22 %), zinc (23 ppm), calcium (0.84 %), magnesium (0.58 %), and iron (474 ppm). But still, there is no research was conducted on seed production aspects particularly either phenology or seed development and maturation.

Phenology is the art of studying the flowering behaviour of crop plants. Studies on phenology are necessary in all agricultural, horticultural and sylvicultural crops for effective practicing of management techniques for better yield and to obtain the quality produce (Mukerjee, 2004). Quality of seed produced in an area depends on genetic, environmental, edaphic and biotic factors prevailing in the production site. One of the environmentally influenced genetic factor deciding the quality of seed is the period and pattern of development and maturation of seed in a

particularcrop. AbdualBaki and Baker (1973) stated that the seed development is a period between fertilization and maximum dry weight accumulation. Therefore at the end of seed development, maturation begins and continues up to harvest. Hence, studies were conducted on phenology, seed development and maturation in Lamb's quarters for producing quality seeds.

MATERIALS AND METHODS

A field experiment was conducted at the Department of Seed Science and Technology, TNAU, Coimbatore during *Rabi* 2018 to find out the flowering behaviour, seed development and maturation. The source seeds were obtained from Horticultural Research Station, Ooty (Tamil Nadu) and the experiment was laid out in Randomized Bock Design (RBD) in three replicates. Ten plants were tagged in each replication and in each plant the phenological observations were made periodically.

The seeds were collected at different days after anthesis (DAA) *viz*.,10,15,20,25,30,35,40 and 45 days and the seed traits were observed. The seed colour was observed by using the Royal Horticultural Society (RHS) colour chart. Seed length and width were measured under Stereo zoom binocular microscope (Euromex Microscope Hollands IMAGE VERSION 1.0).

The data collected were subjected to statistical analysis (Panse and Sukhatme, 1967) and the critical difference values were calculated at 5 per cent probability level.

RESULTS AND DISCUSSIONS

The flowering behavior in Lamb's quarters crop showed that the spike formation has initiated on 35 days after sowing (DAS) and attained 50 per cent at two days after spike initiation (37^{th}day) and it has been completed at five days after spike initiation (40^{th}day). Similarly, anthesis has been initiated at three days after completion of spike formation *i.e.*43 DAS and it reached 50 per cent flowering on 54 DAS and completed on 65 DAS. The spike attainedits maturation on 100 to 105 DAS (Table 1). The number of spikes formed in each plant has been recorded with 650. Similar results were observed in grain amaranthus in which the spike initiation, 50 per cent spike formation and completion of spike formation was on 40, 42 and 43DAS respectively. Also, flowering was initiated at 4 days after spike completion and completed within 57 DAS and the spike attained its maturation on 83 to 87 DAS (Manikandan and Srimathi, 2016). The flowering behavior was varied with different agro climatic conditions, environment prevailed at place of production, genotype and location (Mukerjee, 2004).

Seed development and maturation studies result indicated that about eight different stages were obtained during seed development in Lamb's quarters. During seed development, initially the seeds were in yellow green in colour (RHS N144D) at 10DAA and changed togreyed orange (RHS165B), greyed orange (RHS 177A), black (RHS 202A), purple (RHS N 79 B), brown (RHS N 200 A), greyed brown (RHS N199B) and greyed brown (RHS N199A)during 15, 20, 25, 30, 35, 40 and 45 DAA respectively (Figure 1). The embryo development was also observed during above mentioned days. The observations showed that there was a gradual decline in glassy appearance of embryo (Figure 2). Similarly, the fruit moisture (67.8%) and seed moisture (59.2%) were higher at 10 DAA. Also, the seed fresh weight (0.76mg $seed^{-1}$), seed dry weight(0.24mg $seed^{-1}$), seed length (1.45mm) and seed width (1.41mm) were meagre at early stage (10 DAA). However, it was increased during seed developmental stages and attained highest at 45 DAA. During that stage, fruit and seed had the lesser moisture content of 33.4 and 12.7 per cent respectively. However, the seed fresh weight (2.20mg $seed^{-1}$), dry weight

(1.55mg seed^{-1}), seed length (2.19mm) and seed width (2.17mm) were highest at 45 DAA (Table 2). Therefore, the attainment of this maximum dry weight has been considered as physiological maturity of the seed. Delouche (1973) opined that the seed maturation refers to the morphological, physiological and functional changes that occur from the time of the matured ovules (seeds) are ready for harvest.

Menaka (2000) also observed variation in seed colour (white to shiny dark black)during different stages of seed development in amaranthus. The change in seed coat colour is due to the destruction of in tegumentary vascular system in seed over maturation (Carlson, 1973). The moisture content was gradually decreased at the rate which is inversely proportional to increase in seed fresh weight and dry weight in Lamb's quarters (Figure 3). Similar results were also observed in palak (Chakravarthy, 2004)and amaranthus (Menaka, 2000). This may be due to the loss of moisture content in seed while development and attainment of seed maturity. Meanwhile, on the advancement maturation the loss of moisture content leads to accumulation of food resources during seed development. This finding was in accordance with Metha and Ramakrishnan(1988)and Naik *et al*. (1996) in chilli, Steckel *et al*. (1981) in carrot and Kannath and Devadas (1997) in ash gourd. Reduction in moisture content during maturation was reported earlier in fenugreek (Indira and Dharmalingam, 1996) and tomato (Ramya, 2003). Also, steady accumulation of dry matter during seed maturation phase was reported in pole bean (Arulprabhu, 1998) and pumpkin (Adirai, 1999). The internal seed traits in *C. album* showed that the reserved accumulation of endosperm was noticed in the center of the curved cotyledon (Figure 4). The splitting of two cotyledonary leaves with radicle was also observed in the embryo. In addition, the seeds of lamb's quarters showed no germination at all the stages of observation. However, tetrazolium test results showed that the seeds were viable (Figure 5) and thus, it clearly indicates the presence of dormancy in *C.album*.

CONCLUSIONS

It is concluded that the anthesis of *C.album* (Chakkaraarthi keerai) var. Ooty (Ck) 1 was initiated on 43 DAS and completed on 65 DAS. The seeds were attained its physiological maturity on 45 DAA with maximum dry matter accumulation (1.55 mg seed^{-1}), least moisture content (12.7%)and greyed brown in colour. Also, the seed possess dormancy at the time of physiological maturity and therefore, it needs dormancy breaking treatment for immediate sowing.

REFERENCES

1. *Abdual baki, A.A., & Baker, J.E. (1973). Are changes in cellular organelles and membranes related to vigour loss in seeds?. Seed Sci. & Technol. 1, 89-125.*
2. *Adirai,N.(1999). Seed technological studies in pumpkin (Cucurbita moschata L.) cv. CO 1(Unpublished M.Sc (Ag) Thesis). Tamilnadu Agricultural University, Coimbatore.*
3. *Arulprabhu, C. (1998). Studies on certain aspects of seed production and storage in pole bean (Phaseolus vulgaris L.) (Unpublished M.Sc (Ag) Thesis). Tamil Nadu Agricultural University, Coimbatore.*
4. *Bhargava, A., Shukla, S.,& Ohri, D. (2007). Genetic variability and interrelationship among various morphological and quality traits in Quinoa (Chenopodium quinoa Willd.). Field Crops Res.101, 104-116.*
5. *Chakravarthy, P. (2004). Studies on seed production, processing and storage in palak (Beta vulgaris var. Bengalensis) (Unpublished M.Sc (Ag) Thesis). Tamil Nadu Agricultural University, Coimbatore.*
6. *Delouche, J.C. (1973). Seed maturation seed production manual. Produced co-operatively by N.S.C. & the Rockfeller foundation. pp. 162-165.*

7. *Indira,K., & Dharmalingam, C.(1996). Seed development and maturation in fenugreek. Madras Agricultural journal. 83(4),239-240.*

8. *Sekar, R., & PALANICHAMY, P. A. (2016). Land suitability for major crops in Cauvery basin, Tamil Nadu, India using remote sensing and GIS techniques. International Journal of Research in Applied, Natural and Social Sciences, 4, 9-24.*

9. *Kannath, B., & Devadas,V.S. (1997). Effect of fruit maturity, seed processing and storage methods on seed quality on ash gourd (Benincasa hispida Thumbp). Seed Tech News. 27(1), 2.*

10. *Manikandan, S., & Srimathi, P. (2016). Studies on phenology and positional polymorphism on seed quality of grain Amaranthus cv. Suvarna.An International Science Journal. 7(1), pp. 1-8.*

11. *Mehta, V.A.,& Ramakrishnan, V. (1988). Studies on fruit and seed development in chilli. Madras Agricultural journal. 75(9-10),334-339.*

12. *Menaka, C. (2000). Seed technological studies in amaranthus (A.tricolor) cv. CO 5. (Unpublished M.Sc (Ag) Thesis). Tamil Nadu Agricultural University, Coimbatore.*

13. *Mukerjee. (2004). College Botany. Volume III. New central book agency (P) LTD, Kolkatta. pp. 118-120.*

14. *Bensaha, H., Arbouche, R., & Coulibaly, D. Overview Of Forage Crops In The Region Of Ghardaïa (Northern Algerian Sahara).*

15. *Naik, L.B., Hebbar, S., & Doijode, S. D. (1996). Effect of fruit maturity on seed quality in capsicum (Capsicum annuum L.). Seed Research. 24(2), 154-155.*

16. *Panse, V. G., & Sukhatme, P.V. (1967). Statistical Method for Agricultural Worker. ICAR Publication, New Delhi.*

17. *Ramya, H. (2003). Studies on seed colouring, coating, fruit maturity and fruit size variation on seed quality in tomato (Lycopersicon esculentum Mill) cv. PKM 1 (Unpublished M.Sc (Ag) Thesis), Tamil Nadu Agricultural University, Coimbatore.*

18. *Sanwal, S. K. (2008). Underutilized vegetable and spice crops. Agrobios, Jodhpur. 231-235p.*

19. *Steckel, J. R. A., Gray, D., & Rowse, H. R. (1989). Relationship between indices of seed maturity and carrot seed quality. Annals of applied biology. 114(1), 177-183.*

APPENDIX

Table 1: Studies on Phenology of Lamb's Quarters (Chakkaravarthikeerai) var. Ooty (Ck)1

Characters	Days After Sowing
Days to initiation of spike	35
Days for 50 percent spike formation	37
Days for completion of spike formation	40
Days to initiation of flowering in a spike	43
Days to 50 percent flowering in a spike	54
Days to completion of flowering in a spike	65
Days to maturation	100-105
Number of spike plant^{-1}	650

Table 2: Physical and Physiological Changes in Fruit and Seed During Seed Development and Maturation inLamb's Quarters (Chakkaravarthi keerai) var. Ooty (Ck) 1

Days	Seed Colour	Fruit Moisture Content (%)	Seed Moisture Content (%)	Seed Fresh Weight (mg Seed^{-1})	Seed Dry Weight (mg seed^{-1})	Seed Length (mm)	Seed Width (mm)
10 DAA	Yellow green (RHS N 144D)	67.8	59.2	0.76	0.24	1.45	1.41
15 DAA	Greyed orange (RHS 165B)	61.4	52.4	0.82	0.36	1.68	1.66
20 DAA	Greyed orange (RHS 177A)	54.7	44.7	0.92	0.48	1.74	1.72
25 DAA	Black (RHS 202A)	48.1	38.5	1.14	0.84	1.78	1.75
30 DAA	Purple (RHS N 79B)	43.6	31.8	1.55	1.26	2.09	2.07
35 DAA	Brown (RHS N 200A)	39.5	23.6	1.75	1.33	2.13	2.10
40 DAA	Greyed brown (RHS N 199B)	36.2	17.5	2.12	1.49	2.17	2.15
45 DAA	Greyed brown (RHS N 199A)	33.4	12.7	2.20	1.55	2.19	2.17
Mean	-	**48.0**	**35.0**	**1.40**	**0.94**	**1.90**	**1.87**
SEd	-	0.79	0.88	0.01	0.01	0.06	0.06
CD(P=0.05)	-	1.69	1.89	0.02	0.02	0.13	0.13

DAA*- Days after anthesis

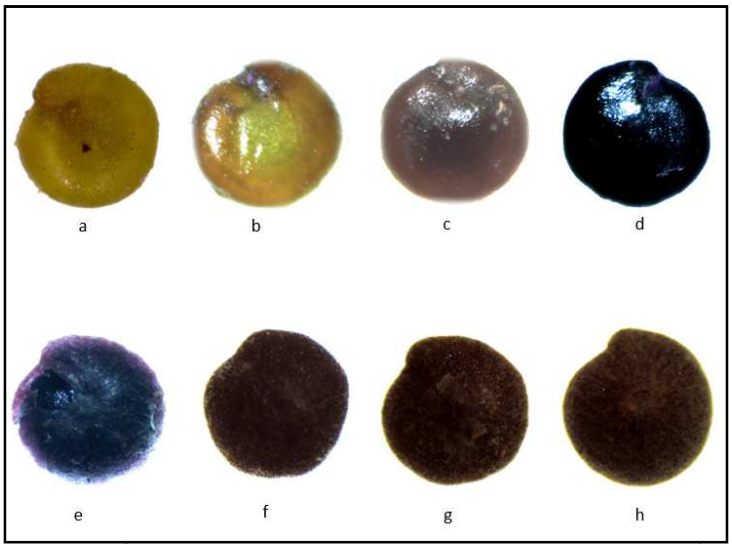

Figure 1: Changes in Seed Colour During Seed Development and Maturation in Lamb's Quarters (Chakkaravarthi keerai) var. Ooty (Ck) 1
a) Yellow green (RHS N144D); b) Greyed orange (RHS165B); c) Greyed orange (RHS 177A) d) Black (RHS 202A); e) Purple (RHS N 79 B); f) Brown (RHS N 200 A) g) Greyed brown (RHS N199B); h) Greyed brown (RHS N199A)

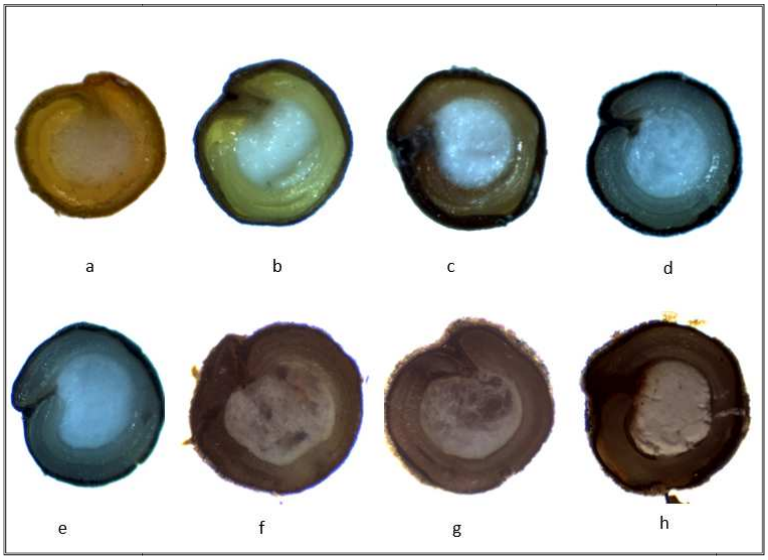

Figure 2: Changes in Embryo Traits During Seed Development in Lamb's Quarters (Chakkaravarthi keerai) var. Ooty (Ck) 1
a)10 DAA; b) 15 DAA; c) 20 DAA; d) 25 DAA; e) 30 DAA
f) 35 DAA; g) 40 DAA; h) 45 DAA

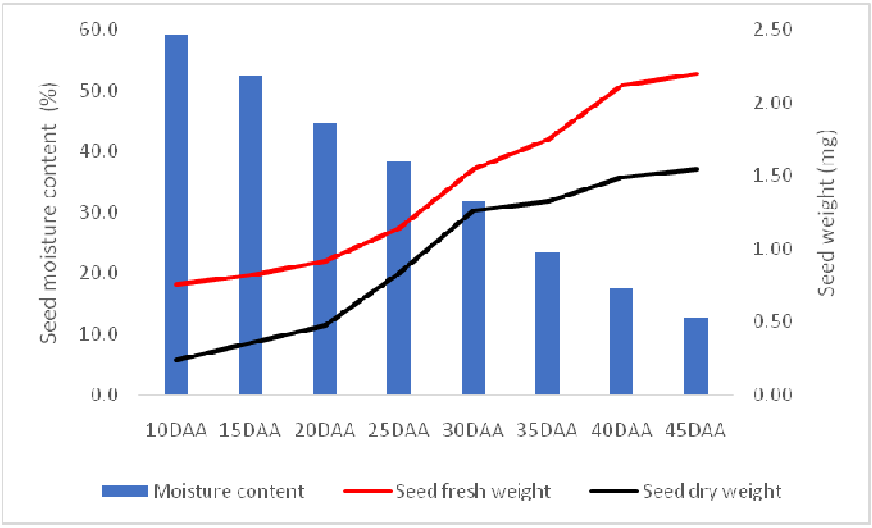

Figure 3: Changes in Seed Moisture Content, Seed Fresh Weight and Dry Weight During Seed Development in Lamb's Quarters (Chakkaravarthi Keerai) var. Ooty (Ck) 1

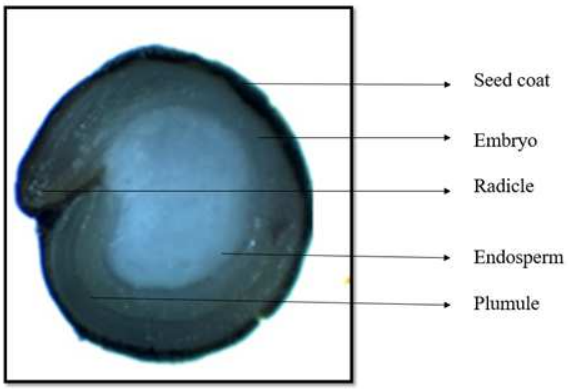

Figure 4: Internal Seed Traits in Lamb's Quarters (Chakkaravarthi Keerai) var. Ooty (Ck) 1

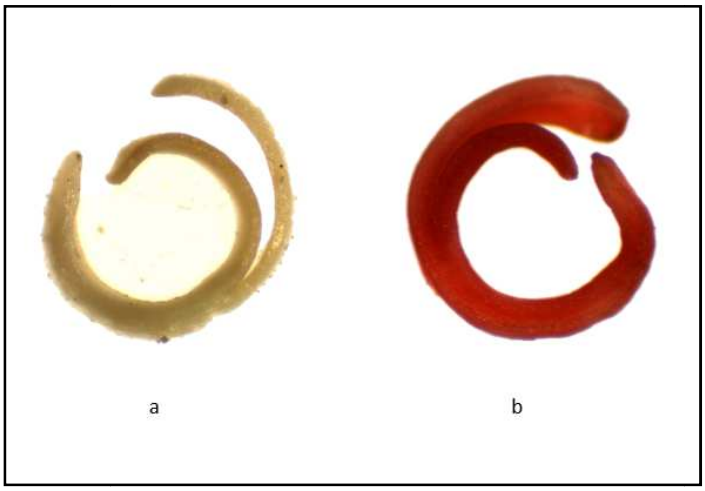

Figure 5: Embryo Viability by Tetrazolium Test During Seed Development in Lamb's Quarters (Chakkaravarthi Keerai) var. Ooty (Ck) 1
a) Normal Embryo (Unstained); b) Tetrazolium Stained Embyro